A Green approach to save energy consumed by software

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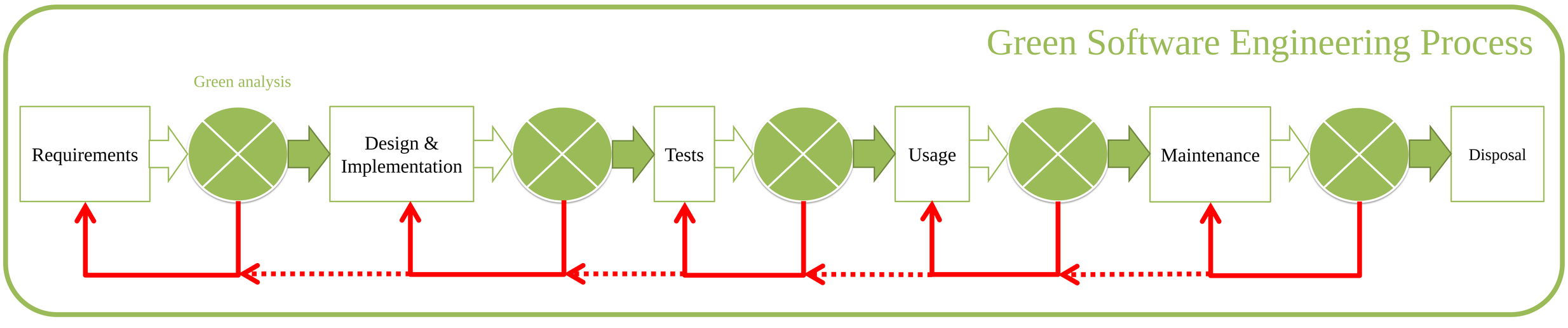
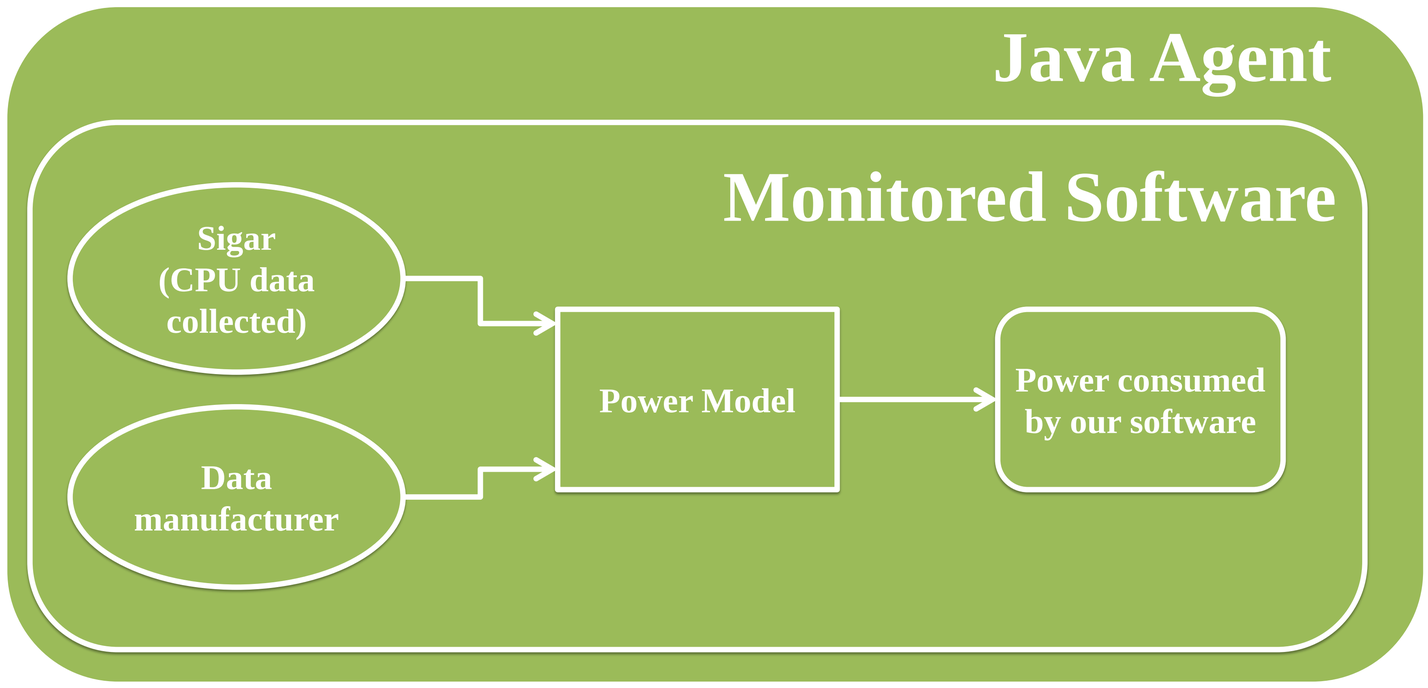
Introduction

- Information and Communication Technologies are responsible around 2% of worldwide greenhouse gas emissions.
- Users of applications through Internet and cloud computing are expanding.
- The energy consumed by informatic programs must be reduced. For this, it is necessary to estimate the power consumed by a software in order to locate the part of code responsible of high energy consumption.
- Several energy measurement tools are proposed, but none of them takes into account all components susceptible to consume energy. This limits their accuracy.

Tools	Power model	Observations
Joulemeter	$E_{System} = E_{CPU} + E_{Memory} + E_{Disk}$	Estimates only the energy consumption due to the software.
vEC	$E_{CPU} = E_{Bus} + E_{Cell} + E_{Pad} + E_{Main} + E_{Add\_bus}$	Measures only the CPU consumption of an application.
Orion	$E = E_{Read} + E_{Write}$	Takes account of the communication components.
Span	$P(t_j, f_i)_{pret} = \Delta P(t_j, f_i)_{pret} + P(f_i)$	In the software code, code is added manually .
PowerAPI	$P_{Software} = P_{Comp} + P_{Com}$	CPU and network power consumption have been considered.

Green analysis added at the end of each step to improve energy efficiency. Assessing the *greenness* of the software.



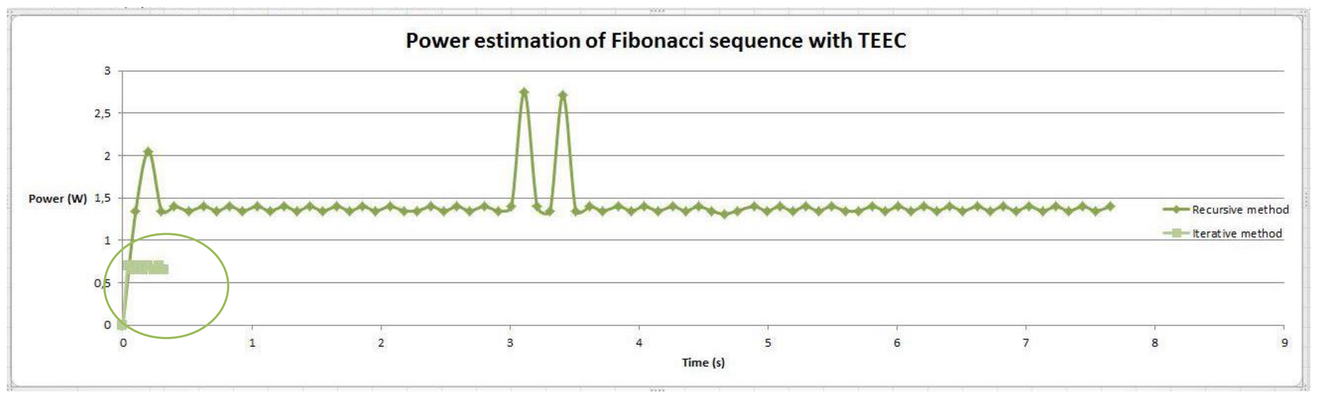


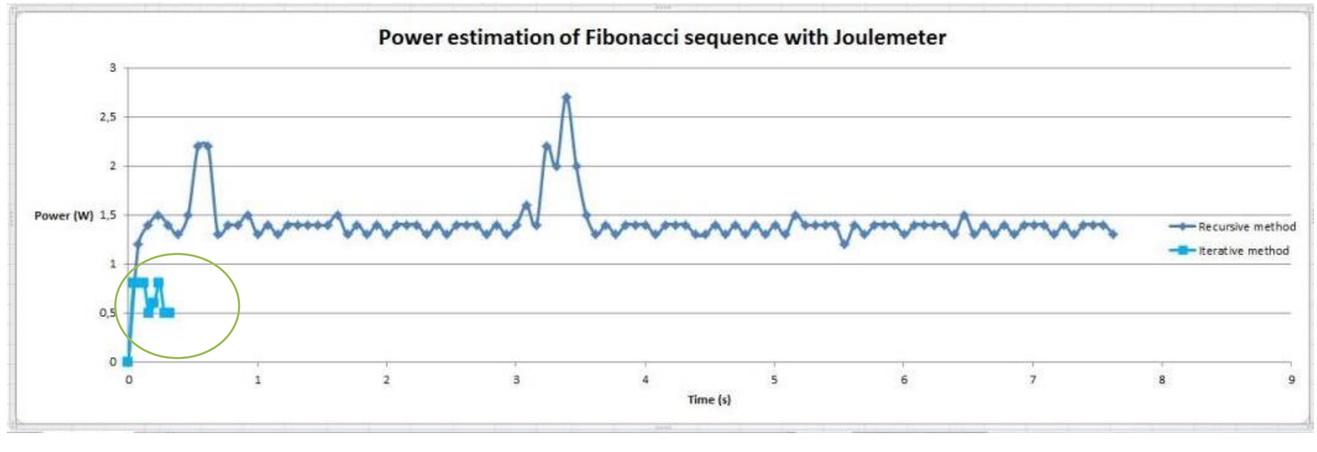
TEEC : Tool to Estimate Energy Consumption

- **Sigar library** allows getting information about the CPU usage. Thus, the id of the ongoing process can be identified and retrieved.
- The form of global variable data providers is formed that allows estimating the energy and assigning a corresponding value.
- **Java Agents** are also utilized, which are the software components that provide with the instrumentation capabilities to an application, such as re-defining the content of class that is loaded at run-time.
- Thanks to TEEC, an estimation about the energy consumed by our application is given at runtime.

Results

- The proposed tool is tested with a program (Fibonacci) that requires a lot of calculation, and therefore heavy use of CPU.
- With the TEEC, the power consumption of Fibonacci sequence using recursive method and iterative method are estimated. The generated test calculates the first 45 values of the Fibonacci sequence with recursive method. For the iterative method, the calculations for the first 5000 value are performed.
- It is observable that quite similar results are obtained for the running application. It shows the effectiveness of the proposed tool and computational model, compared to Joulemeter.
- Moreover, the results reveal that the iterative method is quicker and consumes less power than the recursive method (both in time and amplitude).
- As a future work, the measures will be validated on other applications to demonstrate the precision and accuracy of the proposed model.





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